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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/809,809	03/26/2004	Tetsuya Ikuta	042278	7816

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EXAMINER

LE, THAO X

ART UNIT PAPER NUMBER

2814

DATE MAILED: 05/01/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/809,809

Applicant(s)

IKUTA ET AL.

Examiner

Thao X. Le

Art Unit

2814

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 07 April 2006.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-19 is/are pending in the application.
- 4a) Of the above claim(s) 1-8 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 9-19 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
 2. ☐ Certified copies of the priority documents have been received in Application No. _____.
 3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|---|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____ |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 07 April 2006 has been entered.

Claim Rejections - 35 USC § 102

2. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

3. Claims 9, 12 and 15-19 are rejected under 35 U.S.C. 102(b) as being anticipated by US 6251761 to Rodder et al.

Regarding claims 9 and 12, Rodder discloses a manufacturing method of a semiconductor device comprising the steps of: forming a gate insulation film 106, fig. 2c, over a silicon substrate 102 (semiconductor comprises silicon); and forming a gate electrode 110, col. 4 line 52, over said gate insulation film 106, said step of forming a gate insulation film 106 including the steps of: forming a silicon oxide film 118, column

3 line 16, over said silicon substrate 102; said silicon oxide film having a thickness of 1nm-2nm, col. 3 line 19 ; and introducing nitrogen, fig. 2B col. 3 line 27, into said silicon oxide film 118 and displacing silicon atoms on a surface of said silicon substrate toward said gate insulation film side.

The recitation of 'displacing silicon atoms on a surface of said silicon substrate toward said gate insulation film side' or 'displacing silicon atoms on a surface of said silicon substrate in a region where a conductive type of said surface is P-type below said gate insulation film toward said gate insulation film side, and displacing silicon atoms on said surface in a region where said conductive type of said surface is N-type below said gate insulation film 103 toward an inner side of said silicon substrate', Rodder discloses a products that are produced by identical or substantially identical processes, a *prima facie* case of either anticipation or obviousness has been established. *In re Best*, 195 USPQ 430, 433 (CCPA 1977) and MPEP 2112.01.

Regarding claims 15, Rodder discloses the method according to claim 9, wherein said step of forming a gate insulation film 106 comprises the step of forming a silicon nitride film or high dielectric constant film 108, fig. 2c col. 3 line 55, over said silicon oxide film 118 by deposition, fig. 2c, after said step of introducing nitrogen and displacing silicon atoms.

Regarding claims 16-17, Rodder discloses the method wherein said step of forming a gate insulation film 106 comprises the step of conducting a second heat treatment, col. 4 line 43, to said silicon oxide film to which nitrogen has been

introduced, after said step of forming a silicon nitride film or high dielectric constant film 108, wherein said second heat treatment is conducted at a higher temperature than that at which said silicon nitride film or high dielectric constant is formed.

Regarding claim 18, Rodder discloses the method according to claim 9, wherein said step of forming a gate insulation film 106 comprises the steps of, after said step of introducing nitrogen and displacing silicon atoms, forming a high dielectric constant film 108 over said silicon oxide film 118; conducting a second heat treatment, col. 4 line 43, to said silicon oxide film, to which nitrogen has been introduced, and forming a silicon nitride film 107, col. 4 line 45, over said high dielectric constant film 108.

Regarding claim 19, Rodder discloses the method wherein said the second heat treatment is conducted in a nitrogen monoxide atmosphere, col. 3 line 38.

4. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

5. Claims 9-14 are rejected under 35 U.S.C. 102(e) as being anticipated by US 6548366 to Niimi et al.

Regarding claim 9, Niimi discloses a manufacturing method of a semiconductor device comprising the steps of: forming a gate insulation film 103, fig. 4A col. 4 line 20, over a silicon substrate 101, col. 4 line 15; and forming a gate electrode 402, fig. 4D

col. 5 line 25, over said gate insulation film 103, said step of forming a gate insulation film 103 including the steps of: forming a silicon oxide film 103, column 4 line 20, over said silicon substrate 101; said silicon oxide film having a thickness of 1.5 nm or less, col. 4 line 25; and introducing nitrogen, fig. 2B step 204, into said silicon oxide film 103 and displacing silicon atoms on a surface of said silicon substrate toward said gate insulation film side.

The recitation of 'displacing silicon atoms on a surface of said silicon substrate toward said gate insulation film side', Niimi discloses a products that are produced by identical or substantially identical processes, a *prima facie* case of either anticipation or obviousness has been established. *In re Best*, 195 USPQ 430, 433 (CCPA 1977) and MPEP 2112.01.

Regarding claim 10, Niimi discloses the method according to claim 9, wherein said step of introducing nitrogen and displacing silicon atoms comprises the step of conducting a first heat treatment t_1 , fig. 10, to said silicon oxide film 103 in an ammonia atmosphere or nitrogen monoxide atmosphere, fig. 10.

Regarding claim 11, Niimi discloses the method according to claim 9, wherein said gate insulation film 103 is formed over a region where a conductive type of said surface of said silicon substrate 101 is P-type, column 4 line 11.

Regarding claim 12, Niimi discloses a manufacturing method of a semiconductor device comprising the steps of: forming a gate insulation film 103, fig. 4A, over a silicon substrate 101; and forming a gate electrode 402, fig. 4D, over said gate insulation film 103, said step of forming a gate insulation film including the steps of: forming a silicon

oxide film 103 over said silicon substrate 101, said silicon dioxide film having a thickness of 1.5 nm or less, col. 4 line 25; and introducing nitrogen, 201, fig. 2B, into said silicon oxide film 103, displacing silicon atoms on a surface of said silicon substrate in a region where a conductive type of said surface is P-type, column 4 line 11, below said gate insulation film 103 toward said gate insulation film side, and displacing silicon atoms on said surface in a region where said conductive type of said surface is N-type, column 4 line 11, below said gate insulation film 103 toward an inner side of said silicon substrate 101.

The recitation of 'displacing silicon atoms on a surface of said silicon substrate in a region where a conductive type of said surface is P-type below said gate insulation film 103 toward said gate insulation film side, and displacing silicon atoms on said surface in a region where said conductive type of said surface is N-type below said gate insulation film 103 toward an inner side of said silicon substrate 101', Niimi discloses a products that are produced by identical or substantially identical processes, a *prima facie* case of either anticipation or obviousness has been established. *In re Best*, 195 USPQ 430, 433 (CCPA 1977) and MPEP 2112.01.

Regarding claim 13, Niimi discloses the method according to claim 12, wherein said step of introducing nitrogen and displacing silicon atoms comprises the step of conducting a first heat treatment t_1 , fig. 10, to said silicon oxide film 103 in a ammonia atmosphere or nitrogen monoxide atmosphere, fig. 10, in said region where the conductive type of said surface is P-type, and conducting a plasma nitridation

treatment, column 9 lines 4-8, to said silicon oxide film 24 in an ammonia atmosphere or nitrogen monoxide atmosphere, fig. 10 or 11, in said region where the conductive type of said surface is N-type, col. 4 line 11.

Regarding claim 14, Niimi discloses the method according to claim 10, wherein said first heat treatment is conducted at 775 degree C or higher, fig. 10.

Claim Rejections - 35 USC § 103

6. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

7. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

8. Claims 15-18 are rejected under 35 U.S.C. 103(a) as being unpatentable over US 6548366 to Niimi et al. in view of US 6713358 to Chau et al.

Regarding claims 15-18, Niimi does not disclose the method according to claim 9, wherein said step of forming a gate insulation film 103 comprises the step of forming a silicon nitride film or high dielectric constant film over said silicon oxide film, after said step of introducing nitrogen and displacing silicon atoms, wherein said step of forming a gate insulation film comprises the step of conducting a second heat treatment, to said silicon oxide film to which nitrogen has been introduced, after said step of forming a silicon nitride film or high dielectric constant film and forming a silicon nitride film over said high dielectric constant film.

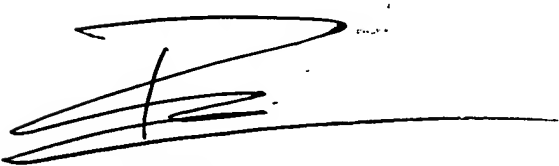
However, Chau discloses a method wherein forming a gate insulation film 120, fig. 1a, comprises the step of forming a silicon nitride film or high dielectric constant 130, col. 2 line 7, film over silicon oxide film 120, col. 2 line 5, wherein said step of forming a gate insulation film 120 comprises the step of conducting a second heat treatment, col. 2 line 46, to said silicon oxide film 120, after said step of forming a silicon nitride film or high dielectric constant film 130 and forming a silicon nitride film 140, col. 2 line 42, over said high dielectric constant film 130. At the time the invention was made; it would have been obvious to one of ordinary skill in the art to use the silicon nitride or high dielectric layer teaching of Chau with Niimi's method, because it would have provided an acceptable gate leakage characteristics as taught by Chau in col. 3 lines 4-5.

Conclusion

9. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Thao X. Le whose telephone number is (571) 272-1708. The examiner can normally be reached on M-F from 8:00 AM - 4:30 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Wael M. Fahmy can be reached on (571) 272 -1705. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

A handwritten signature in black ink, appearing to be 'Thao X. Le', with a long horizontal line extending to the right.

Thao X. Le
27 April 2006